18. Prove that the Dirac electron has a magnetic moment $\mu = e\hbar\sigma'/2mc$.

19. Derive covariant formulation of Dirac equation.

20. State and prove Noethor's theorem.

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APRIL/MAY 2025

23PPH31 — QUANTUM MECHANICS — II

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

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1. Define Scattering Length.

2. State optical theorem.

3. What do you mean by time dependent perturbation theory?

4. State fermi Golden rule.

5. Show two inadequacies of Klein-Gordon Equation.

6. Write down the expression for Dirac matrices.

7. What is meant by Bilinear covariant?

8. What are Feynman graphs?

9. Define Fock state.

10. Distinguish between creation and annihilation operation.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Discuss the scattering by screened coulomb potential and derive Rutherford's scattering formula.

Or

(b) Describe and discuss the method of partial waves for an elastic scattering.

12. (a) Derive Finstein's A and B coefficient.

Or

(b) Write a short note on Sudden approximate.

13. (a) Obtain the plane wave solution of Dirac equation.

Or

(b) Explain the significance of negative Eigen state.

14. (a) Discuss the various properties of gamma matrices.

Or

(b) Derive an expression for the probability density in the Dirac theory.

15. (a) State the classical field and explain Euler Lagrange equation.

Or

(b) Derive the second quantization of K-G Field and explain its significance.

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SECTION C — ($3 \times 10 = 30$ marks)

Answer any THRE questions.

16. Evaluate the scattering amplitude in the born approximation for scattering by the Yukawa potential $V(r) = V_0 e^{-\alpha r}/r$ where V_0 and α are constants. Also show that $\sigma(\theta)$ peaks in the forward direction ($\theta = 0$) except at zero energy and decreases monotonically as θ varies from 0 to π.

17. Explain in detail about constant perturbation.